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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

333 W. Nye Lane, Room 138
Carson City, Nevada 89706

January 27, 2003

Mr. Dave McCarthy
Atlantic Richfield Company
307 E Park Ave.
Anaconda, Montana 59711

SUBJECT: **Draft Groundwater Conditions Work Plan**

Dear Mr. McCarthy:

The Nevada Division of Environmental Protection (NDEP) has received and evaluated the **Draft Groundwater Conditions Work Plan,** dated October 14, 2002, regarding the continued environmental investigation of the Yerington Mine, located in Lyon County near Yerington Nevada. This office provides the following comments from NDEP, EPA, BLM, U.S. Fish and Wildlife and other technical representatives of the Yerington Technical Work Group (YTWG).

NDEP General Comments

The Groundwater Conditions and other site investigation work plans at the Yerington Mine are required by the regulatory agencies for the purpose of evaluating potential sources of contaminants of concern; to determine if contaminants above state action levels have been released to the environment; to determine the potential for migration of contaminants; to determine the potential for exposure and exposure pathways; and to determine appropriate corrective action strategies, if necessary.

Groundwater impacts due to individual potential source areas and groundwater flow and contaminant transport at the mine boundaries will not be adequately characterized by the conduct of this work plan. Evaluation of specific source areas for the purpose of eliminating them from further characterization must be comprehensive and defensible. Understanding of impacts at the mine boundaries is essential for determining appropriate corrective action.

NDEP is concerned that characterization of groundwater flow and contaminant transport at the mine boundaries and individual mine unit source areas will remain inadequate following the completion of the proposed field work described in the work plan. Information must be collected that will support any decisions that address the potential for exposure and contaminant fate and transport. The appropriateness of any required corrective action cannot be accomplished without this required assessment. Public health, environmental and economic impacts warrant proper detection, delineation, and fate and transport procedures and analysis. Failure to provide this information will delay the development of any remediation plans resulting in additional adverse impacts to the community and adjacent properties, to include increased project costs.

However, if Atlantic Richfield Company is prepared to propose reclamation/remediation solutions, that are protective of the environment, public health and assume "worst case" source area and mine boundary contamination, an incomplete characterization at potential source areas may be justified and may be in the best interest of all parties concerned. This approach has potential to resolve difficult environmental concerns in a timely and economically advantageous manner, will minimize any further contaminant impacts on and off site, will minimize the magnitude and liability of these impacts and is encouraged. Further, defensible corrective action will provide economic enhancement of impacted properties. Otherwise, a more comprehensive approach will be required. If Atlantic Richfield is interested in this concept, you should propose alternative defensible rational to the Yerington Technical Work Group. Adaptation of this philosophy could eliminate some of the specific comments described below.

NDEP Specific Comments

Page 3

There is no mention of the acid plant facilities or the Anaconda dump leach. These are both significant mine units and should be noted.

Last paragraph: The sentence on the lined evaporation ponds is confusing. It should be moved to the end or noted that Atlantic Richfield constructed these ponds. A reader who did not know the property would think that Arimetco built these ponds.

Arimetco ceased mining new ore and adding acid and makeup water to the heaps in November 1998 not 1996. Arimetco continued to recover copper from heap drain down fluids until November 1999. The NDEP took over fluid management of the Arimetco Facilities in January 2000.

Page 4

The Anaconda W3 dump leach should be listed here

Section 1.3.8

Should the Anaconda process area wells be noted in this section? Wells WW-10 and MW-01 both show elevated selenium levels. What is the groundwater flow direction in the Anaconda process area? Selenium was a by-product in the acid plant at least during a portion of the 1950's. Records at the mine office show that small quantities were sold up until 1958 as precipitator mist mud.

No monitoring wells exist in the vicinity of the Arimetco Plant site. Additional wells down gradient of this area are warranted to evaluate this potential source area.

Page 15

"Data are not available to characterize groundwater flow conditions in the deeper portions of the alluvial aquifer." Is Atlantic Richfield going to provide sufficient data by executing this groundwater conditions work plan?

Page 30

Quarterly monitoring activities for one year will likely be inadequate to effectively evaluate groundwater conditions. Based on analytical results during the first year, future requirements will be determined.

Page 46

First Bullet: The evaluation of the influence of irrigation pumping is essential for understanding of groundwater flow in the vicinity of the mine. How will these influences be evaluated?

Second Bullet: Please include specific (AHA, 1999) pumping test data, procedures and wells tested.

Page 48

"Presently, no information is currently available on the pumping rates of agricultural supply wells from deeper portions of the aquifer that may affect the shallow alluvial aquifer." How will this and other information regarding affects of pumping be determined?

Bottom of page 49

Selenium should be added as exceeding the primary MCL in WW-10 and MW-01.

Page 51 (3.1 Site Investigations)

Evaluation of the affects of pumping should be included as a site investigation activity in this Groundwater Conditions Work Plan.

Page 53

Please justify screen intervals that are "five feet below the water table". This technique is not standard procedure and will not be adequate to evaluate some of the potential chemicals of concern including hydrocarbons.

Page 54 Groundwater Quality Sampling and Analyses

Monitoring Wells WW-08 and WW-23 should be included in the current quarterly sampling program. This additional information would be helpful in the short term and may help in determining the location of any future additional monitoring wells.

Page 55

Please provide equipment specifications for the "real-time kinematic global-positioning satellite (GPS) device.

Figure 12B and 13B

Iron and Sulfate levels should be included for MW-02 and MW-05 on the contour maps. It seems that there is a lack of data towards the west and south to close these contours. Sample data for well WW-08 would assist in evaluating this area and should be included.

Figures 8A and 8B

It would be helpful to differentiate between the inactive and inaccessible wells. Many wells on the southern half listed (inactive/inaccessible) are accessible and the opposite is true for a lot of the wells noted on the northern end of the property. This would help in determining if any additional wells were to be added to the sampling list in the future.

Figure 14

Why aren't wells MW-01 and WW-10 included in the area of mine-related groundwater?

Figure 19

Additional monitor well locations for consideration:

1.) Between wells WW-10 and WW-59.
2.) Both east and west of WW-10.
3.) The area immediately down gradient of the Arimetco process facility.
4.) How will the Arimetco pond areas be examined to determine possible ground water impacts? These ponds may be in operation for several years or more. If a pond is currently impacting the site, repairs or design changes may be necessary. There have been concerns in the past regarding the Mega and VLT ponds. Repairs were made to the VLT pond by the NDEP in April 2000. Are the water quality improvements in the June 2002 sampling in MW-05 compared to the last sampling in 1999 significant? There was a noticeable improvement in almost all of the constituents except for iron, which increased by more than 100%.

EPA COMMENTS ON THE "DRAFT GROUNDWATER CONDITIONS WORK PLAN" FOR ANACONDA COPPER, YERINGTON, NEVADA

General Comments

We have concerns with the conceptualized direction of ground-water flow at the Site, the level of detail provided in the discussion of specific activities, and the lack of attention paid to ground-water conditions under potential source areas. The conceptual model for hydrogeology at the Site suggests that ground-water flow is from east to west, as illustrated in Figures 10A and 10B. This depiction of ground-water flow does not agree the with information provided in the introduction (Section 1.3.3 Climate), the interpretation of Seitz et al. (1982), or with the regional conceptualization of ground-water flow in the Great Basin (greater precipitation at higher elevations in mountain ranges, mountain-front recharge, discharge to intermontane basins) as presented in literature (Maxey, 1968; Mifflin, 1988). The direction of ground-water flow in the northern area of the Yerington Mine site is indeed complicated by the pumpback well system, irrigation, conveyance and drainage ditches, and agricultural supply wells in the deep aquifer. However, the east to west flow directions upgradient of this area are not logical and potential sources and sinks responsible for these ground-water flow patterns are not presented in the conceptual model. The flow patterns illustrated in the work plan are likely the result of computer interpretation of an irregular spatial distribution of data points (that is, the majority of data points are in the vicinity of the pumpback system and few control points are present through the remainder of the site). Further discussion of this issue is warranted and the Site hydrogeology conceptual model will need to be reevaluated.

The work plan provides limited details on the planned approach for many of the proposed field activities. The proposed drilling, soil/aquifer material sampling, and monitoring well construction methods for are vague, as are soil moisture monitoring and calibration methods. Evaluation of the pumpback well system is alluded to in Table 6 (Piezometers P-O and P-P), but the approach is not discussed in the work plan. More detail on the specific approaches to be used to characterize ground-water flow and contaminant transport should be provided in the work plan. Additionally, the majority of field activities proposed in the plan focus on ground-water conditions along the boundary of the Yerington Mine Site. Relatively few of the investigations address potential source areas and the ground-water conditions (flow and quality) beneath the source areas and at depth in the aquifer.

Understanding ground-water flow and water quality both on and off site are important to characterizing past, present, and future contaminant releases to ground water and assessing the impact of these releases on human and ecological health at downgradient receptors.

Specific Comments on Draft Groundwater Conditions Work Plan:

1. Page 1; Other objectives are appropriate, such as identifying source areas and source control options (page 1). Are there any possible treatability studies that can be incorporated into the early stages of investigation?

2. The text mentions the data summary report, however, if an initial screening of the data indicates that there is a potential risk and that a risk assessment is required, where will this assessment be included (page 1)?

3. Tailings and residual solutions from beneficiation operations were pumped to on-site tailings ponds (p. 3). Infiltration from these ponds may have resulted in the release of contamination to the subsurface. The residual solutions are reported to have had elevated iron and sulfate concentrations. Is there any record of the chemical composition of the residual solutions (major ions, other metals, etc.)? As mentioned in prior meetings, any known spill or process history that may impact groundwater should be included. At a minimum, Atlantic Richfield should review NDEP's records of spills and attempt to interview past employees to determine their potential knowledge of spills and/or industrial practices.

4. Collection and conveyance ditches were used to collect and recycle surface runoff and shallow drainage of residual solutions from the tailings ponds (p. 3, ¶ 2). How might these ditches have influenced contaminant movement and releases at the Site (that is, potential for surface water to ground water release along the course of the ditches)? Investigations of the ditches should be proposed as part of the source investigations.

5. A geologic map and cross sections were provided as Figures 4-6. However, legends were not included. In the future, legends should be provided with these materials to facilitate their understanding.

6. The coalescence of alluvial fan and valley fill deposits along mountain fronts in the Great Basin generally produces complex stratigraphic relationships, both laterally and vertically. Evidence supporting the statement that horizontal hydraulic conductivity values are two orders of magnitude greater than vertical conductivity values (p. 8 and 9) must be provided. This is particularly important because core samples from Atlantic Richfield drilling investigations lacked evidence of bedding and/or laminations in the alluvial deposits (p. 9, ¶ 2) and Seitz et al. (1982) suggested that the shallow and deep portions of the alluvial aquifer were in hydraulic communication with one another.

7. Equipotential maps were generated using hydraulic head data from the pumpback wells. Because of well inefficiency, well loss is likely a major component of the total head loss in the well and therefore actual drawdown in the aquifer will be much less. The change in water levels in the vicinity of the wells is probably not as dramatic as illustrated in the work plan maps (Figures 9, 10A, and 10B). Water table and potentiometric surface maps should be generated with data from observation wells or non-pumping production wells (if the water level in the well has been allowed to recover). Over exaggerated drawdown and inaccurate water table maps will result from using hydraulic head data from production wells while they are in operation.

8. The westerly direction of ground-water flow reported in Section 1.3.2 (p. 12-13) and illustrated in Figures 10A and 10B is contradictory to the information provided in the work plan introduction (p. 15; net gain in water through precipitation in the mountains, net loss in water through evapotranspiration in the basins), findings from a previous investigation (Seitz et al., 1982), and reports on general Great Basin hydrology published in literature (Maxey, 1968; Mifflin, 1988). Precipitation in the Great Basin region is greatest in the mountain ranges and ground-water recharge generally occurs at the mouths of upland watersheds where streams cross alluvial fans. Gaining and losing conditions associated with streams and rivers in the intermontane basins affect local ground-water flow patterns, but ground water generally moves in a downvalley direction. This refraction in ground-water flow lines (from flow towards the valley to flow in a downvalley direction) is due to the large hydraulic conductivity contrast between the upland bedrock and alluvial/fluvial valley deposits. Ground-water flow patterns along the northern boundary of the Yerington Mine Site are complicated by the pumpback system, irrigation, conveyance and drainage ditches, and deep aquifer pumping. Hydraulic heads in this area are a function of all of these positive and negative interferences and can produce a pattern similar to the one illustrated in Figure 10A, although the gradients are probably not as steep because of well inefficiency and the over exaggerated aquifer drawdown associated with the pumpback well heads (see previous comment). However, the east to west ground-water flow pattern illustrated across most of the Site (Figures 10A and 10B) is highly unlikely. This westerly ground-water flow direction likely is an artifact generated by the interpolation algorithm of a computer contouring software package using irregularly spaced data points (note that the majority of data points are along the northern boundary of the site and few control points are present through the remainder of the site). More hydraulic head data must be collected across the Site in order to provide an adequate representation of ground-water flow directions and gradients.

9. Vertical hydraulic gradients in the shallow aquifer along the northern end of the Site are reported in the work plan (p. 14, ¶ 2). How do these values compare to horizontal gradients in this area? The potential exists for developing a diving plume given the subsurface hydraulics to the north (irrigation water applied on the surface and production wells pumping at depth creating downward movement of water in the aquifer system).

10. Pre-1966 water use data for agricultural applications (Section 1.3.6) and well production (Section 1.3.7) in the vicinity of the Site are presented in the work plan. However, no modern data are provided. Current and future agricultural irrigation rates and production withdrawal rates need to be determined to evaluate present-day and future ground-water flow patterns.

11. Figure 13A is actually a copy of the sulfate concentration map (Figure 12A), not the iron concentration map as indicated in the text and figure caption.

12. How many domestic wells were sampled in 1983 (page 22)? Please provide more detail to support the claim that this study area "did not show evidence of contamination."

13. Using a 1,000 mg/l sulfate contour is not appropriate for discussing the domestic well results (page 24). Please use the secondary MCL for sulfate.

14. Data Quality Objectives (DQOs) (page 27); There should also be a problem statement regarding lateral and vertical extent of groundwater contamination (on and off-site).

15. DQOs; The discussion regarding exposure scenarios is incomplete. In order to provide a conservative estimate of risk for comparison, the residential exposure pathway is required to be assessed for each area. After the data is collected, it should be compared to screening values, such as EPA Region IX Preliminary Remediation Goals. At this time, the determination can be made as to the necessity of a risk assessment for a given area. There is also no discussion of the potential for ecological receptors to come in contact with any contaminated groundwater.

16. Wabuska Drain also has the potential to be a continuing source to groundwater (within Step 2) (page 28).

17. Step 3 of the DQO process (Identify Inputs) should also include:

    A) Development of a geochemical model to explain how COCs and groundwater chemistry change as the groundwater and COCs move thru Site soils. Chemical reactions, precipitation of COCs , and changes in valance states of COCs are critical to understanding groundwater chemistry and impacts.

    B) Significance of continuing source areas to groundwater must be understood. Will mine waste materials leach COCs in the future that could migrate into the groundwater. Water quality data from the background locations, the source areas, and the downgradient plumes will be needed to characterize the distribution of COCs in the ground water and to evaluate ground-water mixing and plume dynamics.

C) Understanding pathways of groundwater movement is critical to understanding present and future groundwater contamination and migration. Is the groundwater moving thru discrete lenses? At what depth? Is there communication between the shallow aquifer and deeper aquifers?

18. In addition to collecting water quality data for locally important surface water bodies (Walker River, the Campbell Ditches, and Wabuska Drain), discharge data also should be collected at two locations along each of these surface water bodies. Characterizing reaches as gaining or losing and quantifying these sources and sinks is as important as assessing water quality.

19. Conducting monitoring activities on a quarterly basis for a period of only one year (p. 30 and elsewhere if the work plan) will not provide sufficient data to characterize temporal and spatial trends in ground-water flow directions and COC fate and transport. A longer monitoring time frame is recommended.

20. The water budget reported by Huxel (1969) is for the entire Mason Valley hydrographic basin (p. 34-35) and local deviations from these averages likely exist. Assuming these estimates apply to local hydrologic regimes at all localities across the basin may be inappropriate and potentially misleading when hypothesizing ground-water flow conditions at the Yerington Site.

21. The work plan states that ground-water discharge from the bedrock to the alluvial aquifer is insignificant based on “similar hardrock mining sites in Nevada” (p. 36, 3rd bullet). Supporting references should be provided. What findings (ground-water age dating, stable isotope ratios) justify this statement? Are these “similar mining sites” located along major mountain front faults like the Yerington Mine? Note that ground-water discharges on the order of a few tens to hundreds of gallons per minute along these major faults would have an impact on water balance calculations presented in this work plan (depending on the thickness of the alluvial materials).

22. Discussion of the pre-mining ground-water conditions is based on very limited physical data. While ground-water discharge may have occurred in the northwest area of the site, the generalized statement that “it is unlikely that shallow ground-water flow could have migrated outside of the ground-water discharge/evaporite area,” (p. 36, 6th bullet) is not supported by any conclusive evidence.

23. During mine operations, the continuous ponding of process waters in evaporation and

tailings ponds may have "created very small and localized recharge areas" (p. 37, 3rd bullet). How do these recharge areas compare, from both areal extent and water loading perspectives, to land areas in the north that were irrigated for agricultural purposes?

24. Is all of the water collected by the pumpback well system evaporated back into the atmosphere? Is there any possibility of the evaporation ponds recharging the shallow aquifer?

25. Post mining groundwater(Page 38, Section 2.4); How were the six production wells abandoned? Could they currently be serving as conduits from the shallow aquifer to deeper aquifers?

26. A conceptual site ground-water budget is developed and presented in Section 2.5. While this hydrologic budget is an interesting exercise, the results are speculative given the data at hand.
    a. Applying Huxel's (1969) basin-wide recharge estimates of mountain-front recharge at the Site may be inappropriate.
    b. "The Canyon" is outside of the proposed recharge area for the site. Does the Yerington Pit capture all subsurface flow generated by "The Canyon" as implied in the work plan (p. 41-42).
    c. More accurate estimates of water applied for irrigation purposes are needed, as well as estimates of water gain/loss along the Campbell ditches and Wabuska drain and ground-water withdrawals from pumping.
    d. Ground-water discharge along major faults, or the lack thereof, needs to be better supported.
    e. Does the 268-acre area designated as an evapotranspiration discharge area (p. 44-45) satisfy the depth to ground water and phreatophyte growth criteria presented in Maurer (1997) in order to transfer those evapotranpiration estimates to this site?
    f. The balance is very sensitive to the hydraulic conductivity of the alluvial materials [estimates of which vary from 3 ft/day, reported by AHA (p. 46), to 15 ft/day, reported by Seitz et al. (1982)], as well as the thickness of the "shallow" aquifer.
    g. The work plan stresses that the 30 ac-ft/yr difference between recharge and discharge components in the final balance does not imply that amount of ground-water discharge is migrating off site(p. 48, ¶ 1). However, the ground-water underflow estimate presented in the balance (75 ac-ft/yr) does suggest a large component of flow is not captured by the pumpback well system.

27. Please provide the justification for the selection of the COCs presented in this work plan (pages 49, 50, Page 54 and Table 7). As many different activities, mining and non-mining, are known to have taken place at the Site, the COC list should be expanded to

include PCBs and VOCs. Other COCs, such as arsenic and radionuclides, have been detected above MCLs in several wells (for example, gross alpha with a MCL of 15 pCi/l). For at least the first round and possibly for the first year to establish a sound baseline, a comprehensive list of analytes should be used. Once baseline water chemistry has been established (including waters from background locations, source areas, potential plumes, irrigation, etc.) and potential COCs have been identified, then Atlantic Richfield can propose a target analyte list, which would be a slimmed down version of the initial list.

28. The work plan states that proposed activities will provide data to achieve a variety of objectives (p. 51, ¶ 1) including "evaluation of any current contribution of constituents of concern by surface mine units" (p. 51, 4th bullet). How will this be accomplished? Evaluating ground-water quality immediately underneath potential source areas (existing waste rock and tailings piles, heap 1each pad areas (Anaconda or Arimetco), the old leaching vats and mineral processing area and evaporation ponds) is not discussed in the work plan. It is noted that three wells will be installed to evaluate groundwater in the sulfide tailings area and four wells to evaluate groundwater in the agricultural area. Some wells do exist in these areas, but on numerous occasions the Technical Work Group has expressed the concern that additional wells are needed. Also, investigation (and removal) of the sub-surface water near the Megapond (sampled by EPA–identified as "cellar sample") should be proposed in one of the work plans.

29. The work plan should include a summary of the condition of each monitoring and production well on-site. The integrity of some older wells is questionable, and some of these wells should be physically abandoned and new monitoring wells installed. For example, WW-10 may need to be abandoned and replaced (Page 51).

30. It is noted that no modeling of groundwater chemistry is proposed. Yet developing a good model based on "water types" and accounting for changes in chemistry as the groundwater moves through the alluvial material is important to document that we understand what is happening currently, and what happened historically during mining operations (Section 3.0)

31. Observations of surface water in the Wabuska Drain, West Campbell Ditch, and Walker River channel will be collected to improve the evaluation of ground-water gradients and flow directions (p. 52, 3rd bullet and p. 54). Will surface water measurements be limited to water level elevation data only? Discharge data should be collected at several points to evaluate gaining and losing stream conditions. Water quality data from these water bodies could prove useful in trying to understand the geochemical evolution of waters at the site.

32. "Hydropunch" evaluations have been proposed in the past and may be used at a later date to provide additional water quality data (p. 52). Either the "hydropunch" or the "vertical profiling" technologies could be a useful site characterization/plume delineation tool.

However, these tools should not be used blindly. Once site-wide ground-water flow and water quality data have been collected and evaluated, “hydropunch” or “vertical profiling” technologies could be used to further delineate potential contaminant plumes.

33. Trenching may still be necessary to assess shallow aquifer flow paths, however, it can wait till after installation of new wells (page 52).

34. It is noted that no new wells are planned near the oxide tailings, finger ponds, waste rock piles, leach pads, or the Anaconda mineral processing area and vats. Without wells in these areas it will not be possible to investigate these areas for groundwater COCs or to study the chemistry of the groundwater in these areas and how it changes. Wells should be placed to assess groundwater near these features (page 53 and Figure 19).

35. It is noted that no soil moisture monitoring location was included in the waste rock and leach pads north of the pit lake. Soil moisture monitoring should be included in these areas so that infiltration through these materials can be investigated (page 53, Figure 19).

36. A major objective for new wells and groundwater data collection should be to develop a geochemical model explaining how groundwater changes from former or current source areas, as the groundwater moves thru the alluvium. Additional wells in the southern portion of the mine impacted groundwater are needed to do this (page 53).

37. The drilling and sampling of soil/aquifer materials are discussed in general terms only (p. 53 and 55). Specific drilling and sampling techniques should be proposed so that the adequacy of these techniques under site conditions can be determined.

38. Monitoring sites P-O and P-P are identified as piezometers for evaluating the influence of various wells in the pumpback system (Table 6). However, this is the only explanation provided for investigations of pumpback system efficiency. More detail on the approach proposed to evaluate the pumpback system should be provided in the work plan.

39. Only one intermediate well and one deep well (MW-J-2 and MW-J-3, Table 6) are proposed for monitoring water quality at depth in the alluvial aquifer. Given the lateral extent and potential thickness of the alluvial aquifer in this area, these two monitoring wells will provide a limited amount of data. Additional monitoring wells should be considered in order to characterize ground-water flow and water quality at depth.

40. The description of drilling, sampling, installing, calibrating, and monitoring soil moisture measurement instrumentation is somewhat vague (p. 53 and 63-64). More details need to be provided on the drilling, sampling, and installation techniques to be used. What drilling techniques will be used? How will samples be collected and maintained for use in calibration tests in the laboratory? At what depth intervals will the moisture probes be installed? The methods to be followed for determining soil moisture curves and

calibrating the moisture probes also need to be briefly discussed. The frequency of data collection needs to be reconsidered. The work plan indicates that monitoring will occur on a quarterly basis, however, infiltration will be associated with specific rainfall events and monitoring must be tailored accordingly.

41. Soil moisture sampling/measurement locations should be located adjacent to ground-water monitoring wells to ascertain the potential impact of infiltration on the shallow ground water. Are there any plans for collecting soil moisture samples and analyzing them for the analytes listed in Table 7? This would allow ground-water chemistry to be correlated with leachate chemistry if samples were collected in close proximity to one another.

42. The time period proposed for the majority of monitoring and sampling field activities is quarterly for one year. This relatively short observation period will not be adequate to establish spatial and temporal trends in ground-water flow and water quality. The observation period will need to be lengthened. Perhaps the frequency of water quality sample collection could be reduced to a semi-annual event in the future, pending water quality results for the first year. It is recommended that water level monitoring remain on a quarterly measurement schedule to observe seasonal variations.

43. Are the sampling and analysis strategies proposed in other Site work plans (for instance, work plans characterizing the chemistry and leachability of surface mine units) coordinated with the sampling and analysis strategies proposed in this groundwater conditions work plan? It is important to make sure that findings from field investigations and data analyses proposed under other work plans can also be used to support findings generated by the groundwater conditions work plan and vice versa.

<u>References Cited</u>

Maurer, D.K. 1997. Hydrology and ground-water budgets of the Dayton Valley hydrographic area. U.S. Geological Survey, Water Resources Investigations Report 97-4123.

Maxey, G. B. 1968. Hydrogeology of desert basins. Ground Water 6:10-22.

Mifflin, M. D. 1988. Region 5, Great Basin. Pages 69-78 *in* W. Back, J. S. Rosenshein, and P.R. Seaber (eds.). Hydrogeology, the geology of North America, vol. O-2. Geological Society of America, Boulder, CO.

Seitz, H.R., A.S. Van Denburgh, and R.J. La Camera. 1982. Ground-water quality downgradient for copper-ore milling wastes at Weed Heights, Lyon County, Nevada. U.S. Geological Survey, Open-File Report 80-1217.

Bureau of Land Management
Comments on the October 14, 2002,
Yerington Draft Groundwater Conditions Work Plan,

General Comments

To adequately assess groundwater conditions at the Yerington Mine additional monitoring wells, beyond those being proposed in the Plan, will be necessary. These additional monitoring well installations are justified for several reasons, but primarily due to the lack of coordination between the DQOs of this plan and companion plans, the mere expanse of the site, the uncertainties of the conceptual model (hypotheses testing), and the need to physically abandon and replace some existing monitoring wells that are proposed for continued use.

The uncoordinated groundwater characterization strategies of the various work plans render the groundwater pathway of several mine units inadequately characterized, and therefore, unable to contribute to the risk assessment or the selection of closure alternatives. This plan proposes an indirect and problematic approach of soil moisture probes (three across the entire Yerington Mine Site) for the determination of leachate production, while companion work plans characterize only the upper soils of each mine unit and not the depths which may indicate groundwater problems.

Groundwater pathway characterization efforts presented in this plan must be comprehensive for each mine unit. The most direct and efficient technology for the assessment of groundwater quality is the direct sampling of groundwater via monitoring wells. When taking into consideration the inadequacies of some existing wells and the deficient distribution of proposed wells, it becomes apparent the groundwater pathway is not being characterized for the waste rock piles, oxide tailing pile, process areas, landfills, and leach pads. The monitoring well distribution of existing and proposed wells needs to be reconsidered in order to achieve the DQOs specified in this plan, particularly for mine units in the middle and southern areas of the site.

Some older wells have inadequate completions and/or documentation and should not be used for these investigations. Moreover, several of these wells should be physically abandoned. All historical/existing wells should be reviewed for adequate construction, completion intervals, locations, and documentation regarding the lithologic descriptions. Without adequate knowledge of these wells, they could provide misleading information and conclusions.

Justification for the selection of the Constituents of Concern (COC) should be provided in the Plan. Potential groundwater sources include the unknown mining processes which occurred on over 7 acres of concrete pads, the existence of PCBs, the presence of flammable liquid containers and the likelihood of machine repair shops and fuel depots.

In addition, elevated concentrations of radionuclides were reported in several historical reports, and gross alpha concentrations were documented to exceed maximum concentration limits (MCLs) of 15pCi/l. Unless documentation is provided which justifies the elimination of organic compounds and radionuclides, these parameters should be placed on the COC list.

Specific Comments

Page 3. 1st paragraph, third sentence. *"The resulting … solution was decanted and the remaining solids were placed in the tailing ponds."*

How were these "solids" transported to the tailing ponds? According to other work plans for the Yerington Mine, pipelines and ditches were commonly used to deliver products and wastes. Some of these ditches were unlined.

Page 3. 1st paragraph, last sentence. *"Residual solutions …were conveyed to the evaporation ponds at a rate of 700 gpm."*

According to the Draft Tailings Area and Evaporation Ponds Work Plan (see page 11, section 2.4), this solution was delivered via an unlined ditch. This ditch should also be considered as a mine unit that may have caused groundwater deterioration and therefore investigated. How was the rate of flow, 700 gpm, determined? The location of this ditch should be identified in a figure of this work plan.

Page 3. 2nd paragraph, 2nd sentence. *"Residual solids … were than placed in the sulfide tailing ponds."*

How were these solids transported to the tailing ponds?

Page 3. 2nd paragraph, 4th and 5th sentences.

The slurry that was delivered to the tailing ponds was fully saturated. Was this slurry delivered to the ponds via an unlined ditch? If so, the location of the unlined ditch(es) should be identified and the ditch(es) should be considered as a mine units which may have caused groundwater contamination and its potential impacts to the groundwater pathway should be investigated.

Page 3. Last paragraph, 2nd sentence. *"Arimetco constructed and operated an electro-winning plant …"*

Figure 2 doesn't indicate the location of this specific facility. Is this unit within the "process area" presented in figure 2? What liquids and by-products occurred at this facility?

Page 4. The COCs should also include pathways for geochemical reaction and degradation, via pit wall and water.

Page 4. Include stockpiled ore piles under process areas.

Page 5. Additional information regarding the mine units should be provided so general knowledge of their potential implication to the groundwater pathway can be acknowledged. For example, what activities occurred in the area of the Arimetco electrowinning facility that potentially make it a groundwater source? What constitutes a "pipeline"? Must it [the pipeline] have been know to carry potentially hazardous material or are all pipelines going to be designated as a "mine unit" of concern? Which waste streams were going to the landfill(s) and where are these landfills located?

Characterization of the groundwater pathway must also consider the potential sources, and the constituent(s) of concern which may have been released by a specific mine unit. Additional information regarding the mine units and the possible COCs should be provided in this section of the work plan. Cross-referencing this information to another companion work plan may be possible.

Other ARCo work plans discuss a "Trans-mine Asbestos Pipe" that delivered solutions to the pond areas. Both of these units should be listed by name and their locations provided in this work plan.

Include historical failures of ponds and materials that moved off site past mine boundaries.

Page 7. Last paragraph. A composite lithologic log is provided in this Plan and was generated Seitz via the combining of logs of two (USGS-1A and Anaconda well #35). The general location these two wells, however is not provided. So a better understanding of the geologic setting can be achieved, the Plan should provide a general description of their locations.

Page 8. The description given of lithology materials is not consistent with what the mine's contractors have stated is present in previous communications. We understand that these contractors could have been wrong but this should be clarified.

Page 9. 1st paragraph. As mentioned in the previous comment, presenting the location of these two wells (USGS-1A and Anaconda well #35) is necessary to better understand the information being discussed. Have the names of these wells been changed, because on Figure 8B there are wells USGS-1B and MW-35?

Page 9. 2nd Paragraph. The identification or names of the two wells installed in June 2002, and discussed in this paragraph, should be provided in this paragraph. They are assumed to be MW-2002-1 and MW-2002-2.

Page 24. 2nd paragraph, 3rd sentence. *"Analytical results for dissolved constituents from the June 2002 sampling event for site wells (Table 4) indicate that the area delineated by 1,000 mg/l sulfate contour … figure 12B of this work plan."*

This paragraph is misleading and should be re-written because it confuses the actual results of the June 2002 sampling event. Moreover, the delineation of "mine related groundwater" is not possible without a definition of background. The threshold contour line of 1,000 mg/l is presented in Figure 12B. As presented in Table 4, the June 2002 sulfate results for wells USGS-13 (1,200 mg/l) and MW-2002-2 (1,500 mg/l) exceed 1,000 mg/l, the threshold contour value being discussed in this paragraph and presented in Figure 12B. This paragraph is misleading and should be re-written because the June 2002 sampling results indicate the arbitrary threshold value of 1,000 mg/l is delineated by the current well network. Until background conditions have been characterized, the delineation of the mine related impacts to groundwater cannot be determined.

Page 25. The conclusion that potential mine related groundwater constituents have not impacted the domestic wells is good news and relevant to the characterization effort. However, it is important to clarify that the domestic wells are completed in deeper intervals than the majority of the monitoring wells at the mine. After completing this characterization effort, the hydrostratigraphic relationships between the monitoring wells and domestic wells should be resolved, an element of the DQO's.

Page 28. The Constituents of Concern (COCs) are being proposed in the DQO discussions without providing any documentation which justifies why the COC list is limited to inorganics. Based upon past sampling Sietz et al. and AHA, specific radionuclides are detectable at this site and some are above approved drinking water standards, particularly gross alpha with an MCL of 15 pCi/l. Analysis for radionuclides should continue so an adequate risk assessment can be documented. An essential element of assessing risk and the selection of a closure alternative is thorough documentation.

A table presenting the list of groundwater parameters is provided on page 59, however, no justification for why these parameters have been selected as the COCs has been provided in this work plan. Other Yerington Mine companion work plans acknowledge the presents of transformers containing PCBs, and drums/containers containing flammable liquids, are currently present on site. Furthermore, these other work plans acknowledge the existence of over 7 acres of concrete pads for which there is no record of their mining related purpose. A mine site of this size would need its own mechanical repair shop and fueling depot. How does ARCo know that there isn't any organic contaminant in the groundwater and where has this been previously documented?

Page 28. First Bullet - The last portion of this DQO addresses the adequacy of the data to determine the *"COCs that may be sourced from surface mine units in the future."*
The "adequacy" of the data must first be based upon the quality of the data. This encompasses not only its analytical quality, but also the quality of the well completion and construction. As presented in Appendix A of this Plan, the construction of many older wells is inadequate, and therefore the information that can be obtained from analytical results is questionable. For example, well WW-10 has a perforated casing from 105 ft to 505ft and crosses both the shallow alluvial aquifer and the bedrock aquifers. Water quality results from this well are representing a mixture of two types of water, which is not comparable to wells isolated in a single aquifer. The completions/ construction of these older wells should be reviewed and those with screened intervals which cross two or more known aquifers or lack adequate documentation should be abandoned. Many of the older wells have "sawed" slots, which is not an accepted practice for regulatory monitoring. Many of the older wells have well screens of approximately 20ft, yet this Plan proposes 5ft screens, which do not straddle the water table, but are installed 5ft below the water table. This inconsistency could be problematic.

The DQOs of companion work plans for the Yerington Mine specify that risk to down gradient receptors will be assessed, yet they propose to only characterize the upper portions (1-ft) of the ground's surface. This groundwater work plan proposes the installation of three soil moisture monitoring locations, one in each tailing or waste rock pile. Many of the mine units listed on pages 4 and 5 are not specifically characterized to assess their association to groundwater issues. The various work plans for the Yerington Mine need to be better coordinated to effectively cover the DQOs being presented in all the Yerington Plans. Additional wells are necessary upgradient of the mine and in the middle and southern portions of the site, e.g., process area, south waste rock area, leach pad area etc.

Page 28. Step three. The quality of the historical data needs to be reviewed for adequacy. See previous comment.

Page 29. 2nd paragraph. Also see the comment for page 51. A single background well (MW-A) is proposed to be installed in the alluvial fan near Weed Heights, however, the current monitoring well network encompasses wells completed in bedrock, lacustrine and flood plain deposits. How will the water quality of these wells be compared to background conditions? Will the four quarters of background be "pooled" together and statistically compared to the monitoring wells? Will seasonality be removed? How will spatial variability be addressed? Such information should be provided in a Plan. The proposed effort for the characterization of background conditions should be expanded with additional wells, and specific completions in the various deposits found down gradient and in the current monitoring network.

Page 29. Last paragraph. Also see the comment for page 52 regarding the DQOs. The Spur is "hypothesized" to impede recharge from the Walker River, but the same paragraph admits that the bedrock doesn't impede flow near the Pit. The basis for this hypothesis is questionable, and additional wells are necessary to prove it.

Page 33. Third paragraph. *"Groundwater flow conditions in the Spur are poorly known…"* and *"However, if the hydroponic character of bedrock …will likely be controlled by fractures and boundary conditions resulting from faults and lithologic contacts."* With so much uncertainty of the conceptual model, additional wells should be proposed which will specifically answer this question. Currently wells are not being proposed in this area. In addition, the last sentence of this paragraph also suggests, *"water bearing structural zones"* for dewatering and *"fracture zones"* for recharge. If these aspects of the hydroponic system are important, wells should be proposed to quantify these issues. On page 52 of this plan (last sentence), additional wells are to be installed for hypothesis testing related to the site conceptual hydrogeologic model.

Page 34. Second Paragraph. Similar to the previous comment, this paragraph discusses how bedrock impedes flow, however, these same features have been stated to be important to the dewatering and recharging of the pit. Additional well are necessary.

Page 38. First and last bullets. The companion work plan should be specified by name.

Page 39. First bullet. The companion work plan should be specified by name.

Page 39. The large cone of depression for the pit may also have drawn contaminants downward into the bedrock.

Section 3.0 Work Plan:

The following comments cross reference to Table 6, which presents the rationale for each proposed monitoring well, piezometer, surface water sampling point, and soil moisture monitoring stations.

Page 51. 1st bullet. "*Additional assessment of ambient or background groundwater quality.*" Assessment of background conditions should first consider the site conceptual model. For this site, such a model is complex, and this Plan states the model's uncertainties in understanding groundwater flow due to the unknown relationships of structural boundaries, sediment facies, fracture zones, recharge zones etc. Groundwater quality is partially controlled by the lithologic makeup of the aquifers and residence time of the ground water. As discussed in this Plan, four basic aquifer units exist and are composed of alluvial fans, mineralized bedrock, lacustrine deposits and fluvial deposits. Similarities and differences in groundwater quality amongst existing wells, completed in the various deposits, must be documented before the number and location of background wells can be proposed. Specifying the DQOs for all of the existing wells would assist this process and should be provided in this Plan.

Based upon the information provided in this Plan, the proposed well MW-A is the only background well in this study and because it is completed in an alluvial fan near the recharge zone, its water quality will differ from those in the bedrock, and likely that of the lacustrine and fluvial deposits. The accuracy of future management decisions will be based upon the completeness of defining background conditions. This Plan should provide a more detailed approach for defining background.

Page 51. 2nd bullet. *"Improved definition of groundwater flow directions in the area of the mine site."* As previously stated, the integrity and adequacy of some older wells are questionable, and several wells should be physically abandoned and some not considered for further investigations at the mine. Several of these wells are located in the heart of the mine site were fewer wells exist. For example, WW-10 and WW-59. Replacement wells are necessary for these older wells. Per the DQOs of this plan and those of companion plans, the potential impacts to groundwater by the mine units are to be investigated. With so few adequate wells, the current well distribution within the middle and southern portions of the site will not fulfill the DQOs. This Plan should propose additional wells so adequate information can be supplied to the risk assessment and the selection of closure alternatives.

Page 51. 4th bullet. The distribution of wells (over 2,000 feet apart) in the middle and southern portions of the mine is too sparse to confidently evaluate the groundwater conditions in these areas and adequately comply with the DQOs of this plan and the companion plans. Specifically, the process area has one existing well and no new wells are being proposed, the waste rock pile has no existing wells and none are being proposed, and the various leach pads have three wells and no new wells are being proposed. Arimetco recovered minerals from the waste rock pile, therefore, they could also be a source for groundwater contamination. As stated in the previous comment, some of these existing wells are inadequate and should not be utilized in this work- plan. Characterization strategies for this portion of the mine should be reconsidered and additional wells should be proposed.

Page 51. 6th bullet. *"Evaluation of recharge and discharge components to the alluvial groundwater flow system beneath the mine site."*
With the installation of additional wells (see previous comment) this objective can be achieved.

Page 51. Section 3.1, 2nd bullet. The evaluation of existing well completions and their information integrity should be added to this effort, but preferably before the approval of this work plan.

Page 52. 2nd bullet. Adequate sampling and characterization of these areas are necessary to document their homogenous nature. Companion work plans propose the sampling of only the upper 1-ft of these units and no additional sampling is proposed in this work plan. Without adequate documentation, which should be based upon quantified sampling regarding the homogenous nature of the piles, installation of additional soil probes should be required in these large areas. Moreover, the best method for monitoring potential leachate production is monitoring the groundwater beneath the unit. Relying on assumptions and vadose modeling is problematic and sometimes inaccurate.

Page 52. Last sentence. To ensure all the hypotheses mentioned in the conceptual model are being addressed, the rationale (DQOs) for all the existing wells should be presented in this Plan. A previous comment regarding this issue was made. Additional wells are necessary to answer all the hypotheses and uncertainties mentioned in the conceptual model.

Page 54 and Table 7. The rationale for the selection of the Constituents of Concern (COCS) should be provided in this Plan. Because unknown mining processes, PCBs, flammable liquid containers and the likelihood of machine repair shops and fuel depots the COC list should be expanded to include VOC compounds. In addition, elevated concentrations of radionuclides were reported in several historical reports and many wells exceed established MCLs, specifically for gross alpha (MCL of 15 pCi/l). Because no documentation has been provided which eliminates these parameters as a COC, both organic compounds and radionuclides should remain on the COC list.

Page 55. The number of monitoring wells necessary to assess water quality/background would approximate about five times as many as proposed, i.e. about 65 new monitoring wells in strategic locations to monitor zones necessary to make appropriate evlauations.

Page 57. Last paragraph, 4th line. *"… for selected monitoring wells and domestic wells…"* Clarification is needed for this statement. The Plan suggests all wells will be sampled for all COCs, however, this statement infers a prioritization or hierarchy of sampling parameters for the "selected wells".

Comments on Appendix A:

Appendix A presents many well logs. Because the quality of some of these wells is questionable, their ability to provided accurate information from which risk and/or closure alternatives should be based is a concern. When cross referencing the logs presented in Appendix-A to the wells shown on Figure 19 (the proposed well locations) many of the Appendix-A wells are missing from Figure 19. The opposite also exists. See the following lists:

Logs provided, but Location not shown in Figure 19:
W5AA-2, W5AB-1, W5DB, W4CB-1, Well #26, Well #22, Old Well #29, Old Well #35, New Well #35, and Well –12C.

Location indicated in Figure 19 is provided, but Log is not provided in Appendix A:
MW-3, USGS-13, W32DC, MW-2002-1, W5BB, MW-2002-2, PWELL-4, WW-36, D5AC-1, PW-05, PW-04, and PW-01.

A review of the Appendix A logs revealed the following problems:

<u>Incomplete Records</u>

W4CB-1; one record shows TD is 240 feet, but only shows lithology descriptions to 90 ft and a second page showing drill logs beyond 90ft is not provided. Another well with same ID number (W4CB-1) is provided which has only a 91 ft TD. Where is the log from 91ft to 240 ft?
W5DB; the second page is not provided.
WW-10; over generalized lithology log.
Well#59 is assumed to be WW-59, but confirmation is needed. Also has an over generalized lithology log.
WW-1; no lithology log is provided.
WW-2; no lithology log is provided.
Well #22; over generalized lithology log.

<u>Illegible Records</u>

Screen intervals for wells MW-1, and MW-5 were highlighted which hindered the reproduction/copying of these logs.

Construction Errors *Excessive Screen Length*: W5DB (30ft), WW-10 (400ft) and crosses aquifers, WW-59 (390ft), Well #26 (272ft) and crosses aquifers, Well #22 (337ft), Old Well #29 (250ft), Old Well #35 (387ft), New Well #35 (100ft), Well-12c (255ft),

Sawed Perforation: MW-1, MW-2, MW-4,

Excessive gravel pack: MW-1, MW-2, MW-4, New Well #35,

Unusual Construction: W5AA-1, W5AB-1, W5DB; a second blank casing interval exists below the well screen. This second interval must be recognized so sufficient amounts of groundwater are purged prior to sampling

Accordingly, please provide the **Draft Final Groundwater Conditions Work Plan** which incorporates the above comments. This information must be received not later February 26, 2003, as per approved submittal schedule.

Should you have any questions or if I can be of any assistance, please do not hesitate to contact me at (775) 687-9376 or FAX (775) 687-6396. All future correspondence regarding this subject should be addressed to the undersigned.

Sincerely,

Arthur G. Gravenstein, P.E.
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